



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/608,042	06/30/2003	Stephen J. Leary	84693 3011 TAL	4729
20736	7590	07/27/2006		
MANELLI DENISON & SELTER 2000 M STREET NW SUITE 700 WASHINGTON, DC 20036-3307			EXAMINER THANGAVELU, KANDASAMY	
			ART UNIT 2123	PAPER NUMBER

DATE MAILED: 07/27/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

<b>Office Action Summary</b>	<b>Application No.</b> 10/608,042	<b>Applicant(s)</b> LEARY ET AL.	
	<b>Examiner</b> Kandasamy Thangavelu	<b>Art Unit</b> 2123	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 30 June 2003.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-11 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-11 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 30 June 2003 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All    b) ☐ Some \* c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)  | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date <u>June 30, 2003</u> . | 6) <input type="checkbox"/> Other: _____  |

### **DETAILED ACTION**

1. Claims 1-11 of the application have been examined.

#### ***Foreign Priority***

2. Acknowledgment is made of applicant's claim for foreign priority based on an application 0217090.0 filed in Great Britain on July 24, 2002. Receipt is acknowledged of papers submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file.

#### ***Information Disclosure Statement***

3. Acknowledgment is made of the information disclosure statements filed on June 30, 2003 together with a list of patents. The patents have been considered.

#### ***Drawings***

4. The drawings submitted on June 30, 2003 are objected to. The drawings are light and therefore, several lines and the text in the boxes are not readable. The applicants are directed to provide clear readable drawings in reply to this office action.

***Abstract***

5. The abstract is objected to because of the following informalities:

Line 14, "compensated by the adjusted by the adjusted" appears to be incorrect and it appears that it should be "compensated by the adjusted".

Appropriate correction is required.

***Specification***

6. Page 2, Line 18, "expensive result in a useful compromise" appears to be incorrect and it appears that it should be "expensive result is a useful compromise".

Page 3, Line 12, "approach has limitations applicability" appears to be incorrect and it appears that it should be "approach has limitations of applicability".

Appropriate corrections are required.

***Claim Rejections - 35 USC § 101***

7. 35 U.S.C. 101 reads as follows:

Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

8. Claims 7 and 10 are rejected under 35 USC §101, since computer program per se cannot be patented. **Functional descriptive material per se** and computer programs representing **computer listings per se** are data structures **not claimed as embodied in computer readable storage medium**. These are **not statutory**, because they are not capable of causing functional change in the computer. They do not define any functional and structural interrelationships between the data structure and other claimed aspects of the invention which permits the data structure's functionality to be realized

### ***Claim Rejections - 35 USC § 103***

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.

10. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35

U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

11. Claims 1 and 6-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Shah** (U.S. Patent 6,801,881) in view of **Wegerich et al.** (U.S. Patent Application 2002/0087290), and further in view of **Bishop et al.** (U.S. Patent 6,633,621).

11.1 **Shah** teaches method for utilizing waveform relaxation in computer-based simulation models. Specifically, as per claim 1, **Shah** teaches a method of generating a multifidelity model of a system (Abstract, L1-8 and L17-24; CL3, L1-13; CL9, L21-29; CL10, L51-61), comprising the steps of:

(b) providing a low fidelity model of the system (Abstract, L17-24; CL3, L1-13; CL10, L51-61).

**Shah** does not expressly teach (a) obtaining training data from a high fidelity model of the system; and to optimise the correlation of the low fidelity model, when compensated by the compensation model, with said training data. **Wegerich et al.** teaches (a) obtaining training data from a high fidelity model of the system (Abstract, L1-8; Page 1, Para 0003, L5-8; Page 2, Para 0014, L1-14; Page 2, Para 0016, L20-22); and to optimise the correlation of the low fidelity model, when compensated by the compensation model, with said training data (Abstract, L1-8; Page 2, Para 0014; Page 2, Para 0015, L1-6; Page 6, Para 0063, L11-13). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the method of **Shah** with the method of **Wegerich et al.** that included (a) obtaining training data from a high fidelity model of the system; and to optimise the correlation of the low fidelity

Art Unit: 2123

model, when compensated by the compensation model, with said training data, because that would allow modeling real time processes using aggregate sensor information to ascertain the state of the processes (Page 1, Para 0003, L5-8); and build a representative training set from a larger data collection for empirical modeling of a process or machine (Page 2, Para 0014, L1-3).

**Shah and Wegerich et al.** do not expressly teach the low fidelity model having adjustable weightings for respective input parameters to the low fidelity model; (c) providing a compensation model to compensate for discrepancies between the high and low fidelity models; and (d) adjusting the compensation model and the weightings. **Bishop et al.** teaches the low fidelity model having adjustable weightings for respective input parameters to the low fidelity model (CL2, L33-35; CL6, L50-58; CL7, L63-65; CL8, L8-12; CL9, L60 to CL10, L6); (c) providing a compensation model to compensate for discrepancies between the high and low fidelity models (CL7, L54-60); and (d) adjusting the compensation model and the weightings (CL2, L33-35; CL6, L50-58; CL7, L63-65; CL8, L8-12; CL9, L60 to CL10, L6; CL7, L54-60). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the method of **Shah and Wegerich et al.** with the method of **Bishop et al.** that included the low fidelity model having adjustable weightings for respective input parameters to the low fidelity model; (c) providing a compensation model to compensate for discrepancies between the high and low fidelity models; and (d) adjusting the compensation model and the weightings, because that would allow generating highly available and accurate signals by combining the errors of individual signals by weighting each signal depending on how much the system would like the individual signal to influence the final output (CL2, L27-35).

**Shah** teaches (e) generating a multifidelity model of the system based on the adjusted low fidelity model (Abstract, L1-8 and L17-24; CL3, L1-13; CL9, L21-29; CL10, L51-61).

**Shah** and **Wegerich et al.** do not expressly teach (e) generating a multifidelity model of the system based on the adjusted low fidelity model when compensated by the adjusted compensation model. **Bishop et al.** teaches (e) generating a multifidelity model of the system based on the adjusted low fidelity model when compensated by the adjusted compensation model.

Per claim 6: **Shah** teaches that model is selected from the group comprising stress, strain, fluid flow and thermal (CL7, L29-35).

Per claims 7-10: **Shah** teaches Computer readable program code for implementing the method of claim 1; Computer readable media carrying program code for implementing the method of claim 1; A computer system operatively configured to implement the method of claim 1; and Computer readable program code for implementing a multifidelity model generated using the method of claim 1 (Fig. 2A; Fig. 4A; Fig. 4B; CL2, L63-67; CL2, L48-52).

12. Claims 2-5 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Shah** (U.S. Patent 6,801,881) in view of **Wegerich et al.** (U.S. Patent Application 2002/0087290), and further in view of **Bishop et al.** (U.S. Patent 6,633,621) and **Jin et al.** (U.S. Patent Application 2002/0138457).



Art Unit: 2123

12.1 As per claims 2-3, **Shah, Wegerich et al.** and **Bishop et al.** teach the method of claim 1. **Shah, Wegerich et al.** and **Bishop et al.** do not expressly teach that the compensation model is a kriging model; and the compensation model is a neural network. **Jin et al.** teaches that the compensation model is a kriging model (Page 1, Para 0022, L1-6); and the compensation model is a neural network (Page 1, Para 0022, L6-9). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the method of **Shah, Wegerich et al.** and **Bishop et al.** with the method of **Jin et al.** that included the compensation model being a kriging model; and the compensation model being a neural network, because that would allow evolutionary optimization to guarantee the correct convergence of the evolutionary algorithm and reduce the computation costs as much as possible (Abstract, L2-6); and result in robust optimizers that are well suited for discontinuous and multi-modal objective functions (Page 1, Para 0018, L1-3).

12.2 As per claims 4-5, **Shah, Wegerich et al.** and **Bishop et al.** teach the method of claim 1. **Shah, Wegerich et al.** and **Bishop et al.** do not expressly teach that the system comprises a gas turbine engine or a part of a gas turbine engine; and the part of the gas turbine engine comprises a bearing housing. **Jin et al.** teaches that the system comprises a gas turbine engine or a part of a gas turbine engine; and the part of the gas turbine engine comprises a bearing housing (Page 1, Para 0018, L3-8).

12.3 As per claim 11, **Shah** teaches a method of generating a multifidelity model of a system (Abstract, L1-8 and L17-24; CL3, L1-13; CL9, L21-29; CL10, L51-61), comprising the steps of:

(b) providing a low fidelity model of the system (Abstract, L17-24; CL3, L1-13; CL10, L51-61).

**Shah** does not expressly teach (a) obtaining training data from a high fidelity model of the system. **Wegerich et al.** teaches (a) obtaining training data from a high fidelity model of the system (Abstract, L1-8; Page 1, Para 0003, L5-8; Page 2, Para 0014, L1-14; Page 2, Para 0016, L20-22).

**Shah** and **Wegerich et al.** do not expressly teach providing to compensate for discrepancies between the high and low fidelity models. **Bishop et al.** teaches providing a kriging model to compensate for discrepancies between the high and low fidelity models (CL7, L54-60).

**Shah, Wegerich et al.** and **Bishop et al.** do not expressly teach providing a kriging model to compensate for discrepancies between the high and low fidelity models; (d) adjusting the kriging model to maximise the likelihood of said training data when the low fidelity model, compensated by the kriging model, is used to model the system; and (e) generating a multifidelity model of the system based on the low fidelity model when compensated by the adjusted kriging model. **Jin et al.** teaches providing a kriging model to compensate for discrepancies between the high and low fidelity models; (d) adjusting the kriging model to maximise the likelihood of said training data when the low fidelity model, compensated by the kriging model, is used to model the

Art Unit: 2123

system; and (e) generating a multifidelity model of the system based on the low fidelity model when compensated by the adjusted kriging model (Page 1, Para 0022, L1-6).

### ***Conclusion***

13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dr. Kandasamy Thangavelu whose telephone number is 571-272-3717. The examiner can normally be reached on Monday through Friday from 8:00 AM to 5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Paul Rodriguez, can be reached on 571-272-3753. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.


Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to TC 2100 Group receptionist: 571-272-2100.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only.

Art Unit: 2123

For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic

Business Center (EBC) at 866-217-9197 (toll-free).



K. Thangavelu  
Art Unit 2123  
July 22, 2006